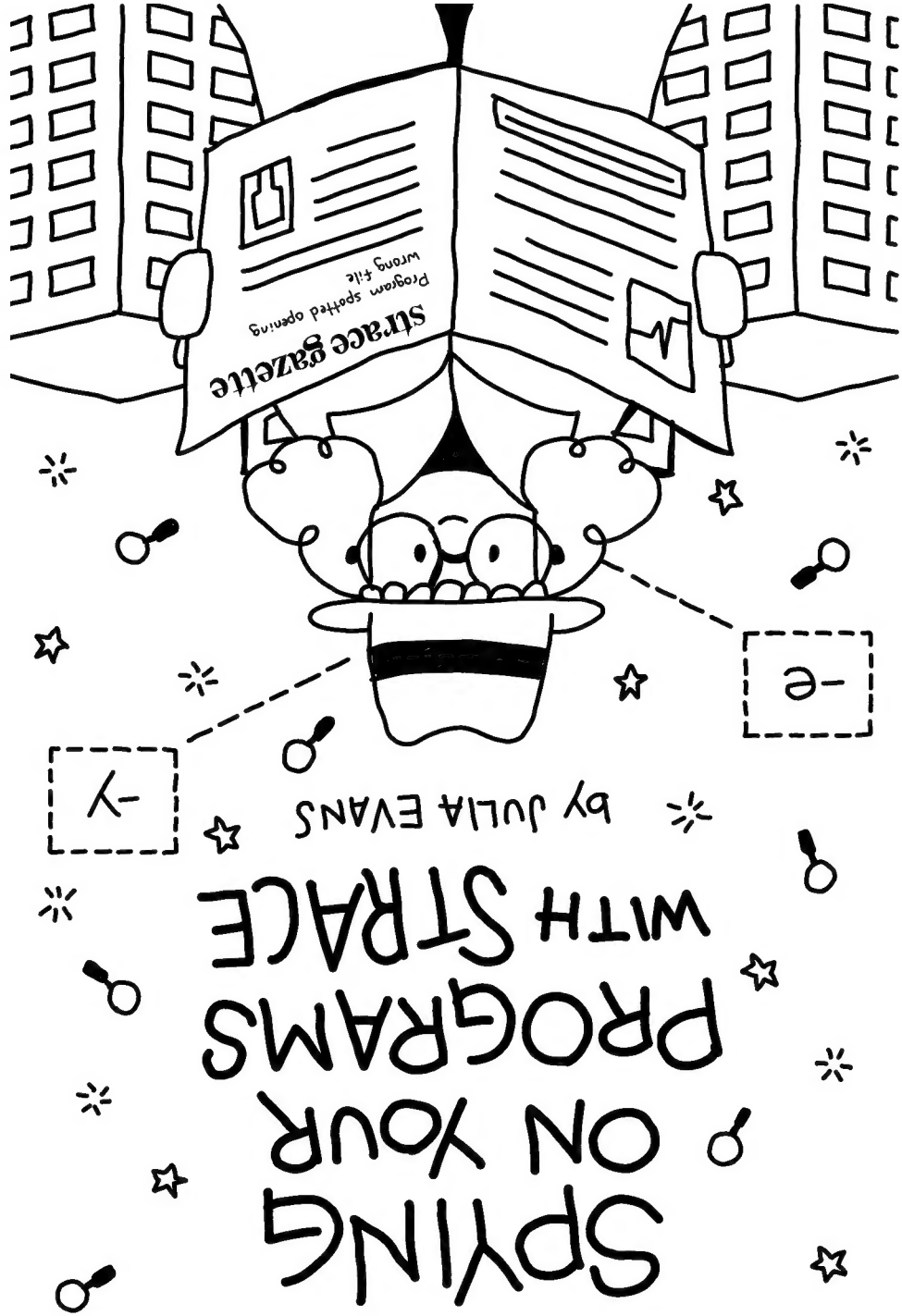




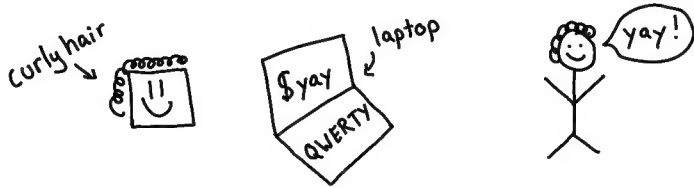
like this ?
you can print more !
for free !
<http://jvns.ca/zines>

CC-BY-NC-SA
Julia Evans, strace wizard wow fun industries 2015



Who makes this?

Hi! I'm Julia! I look kind of like this:



I found out last year that understanding your operating system's internals a little more makes you



and it was SO FUN and I wanted to tell EVERYONE. So I'm telling you! ☺☺☺

I write more like this at

blog: jvns.ca
twitter: @b0rk
email: julia@jvns.ca

Resources + FAQ

I've written like 7 posts about strace because I have an unhealthy obsession. They're at

jvns.ca/categories/strace

(In)frequently asked questions:

Q: Is there strace on OS X?

A: No, but try dtruss/dtrace!

Q: Can I strace strace?

A: Yup! If you do, you'll find out that strace uses the ptrace system call to do its magic.

Q: Should I strace my production database?

A: NONONONO. It will slow down your database a LOT.

Q: Is there a way to trace system calls that won't slow down my programs?

A: Sometimes you can use `perf trace` on newer Linux versions

That's it! Now you're a

WIZARD

More seriously, there's obviously a TON more to learn about operating systems and many further levels of wizardry. But I find just strace by itself to be an incredibly useful tool.

And so fun! On a 12-hour train ride from New York to Montreal, I had no book and no internet so I just started stracing programs on my computer and I could totally see how the 'killall' program works without reading the source code or ANYTHING.

and it helps me debug all the time ☺

★ happy stracing ★

☺ a tiny manifesto ☺

operating systems are

AWESOME

the strace zine thinks:

- your computer is yours

- your OS is yours

- open licenses mean you can

READ AND CHANGE THE CODE!!

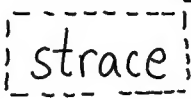
- Linux is REALLY COOL

LET'S GO LEARN

-----> it's really fun ----->

-----> yaaaaay ----->

what is this strace thing????

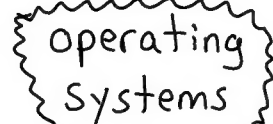
 <sup>pronounced
ess-trace</sup> *(on OSX
you can use
dtrace/dtruss)* is a program on Linux ^{spy on} that lets you ~~inspect~~ what a program is doing without

- a debugger
- or the source code
- or even knowing the programming language at all (?!!?! how can it be!)

Basically strace makes you a

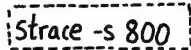
 


To understand how this works, let's talk a little about

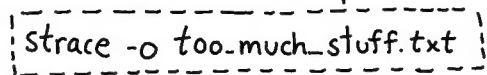
 operating systems


is for
strings!!


Sometimes I'm looking at the output of a `recvfrom` and it's like
`recvfrom(6, "And then the monster...")`
and OH NO THE SUSPENSE

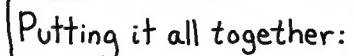
 will show you the first 800 characters of each string. I use it all the time ★


is for
output!

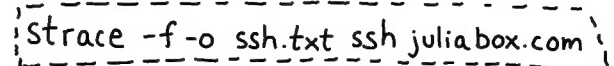
Let's get real. No matter what, `strace` prints too much damn output. Use

and sort through it later.



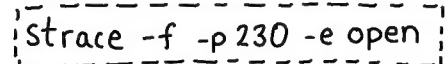
Have no idea which file the file descriptor "3" refers to?  is a flag in newer versions of `strace` and it'll show you filenames instead of just numbers!

 Putting it all together:

Want to spy on a ssh session?



See what files a Dropbox sync process is opening?
(with PID: 230)

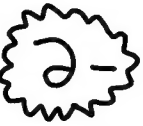


strace command line
flags I ♥

overwhelmed by all the system calls
you don't understand? Try

strace -e open

and it'll just show you the opens. much simpler ♥



f is for
follow

Does your program start subprocesses? or

Use `[-f]` to see what those are doing too.
Or just always use `-f`! That's what I do.



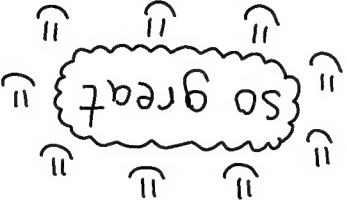
p is for
PID

"OH NO I STARTED THE PROGRAM
6 HOURS AGO AND NOW I WANT TO
STRACE IT"

tip: if the process
runs as root you'll
need to be root
too because
SECURITY

Do not worry! Just find your
process's PID (like 747) and

strace -p 747



Some things it does for you:

- understand how your hard drive works and
how the filesystem on it organizes the bytes
into files so you can just read your damn file!!
- run code every time you press a key so
that you can type

- implement networking protocols like TCP/IP so
that you can get ~~webpages~~ pictures of cats
from the internet

- keep track of all the memory every process is using!
- basically know everything about how all your
hardware works so you can just write
programs! ♥

Why you should ♥ your
operating system! ★

you

amazing!

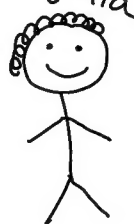
SYSTEM
CALLS!!!

Wow! ★

yay!


★

julia



System calls are the ^{interface} API for your operating system

Want to open a file? use `open` and then `read` and `write` to it


 sending data over a network? Use `connect` to open a connection and `send` and `recv` pictures of cats.

Every program on your computer is using system calls all the time to manage memory, write files, do networking, and lots more.

connect

Sometimes a program is sending network requests to another machine and I want to know WHICH MACHINE.

```
strace -e connect:
```

Shows me every IP address a program connects to.

```

001101010010100
|
0
|
0
|
0
|
0
|
001101010010100

```

sendto
+
recvfrom

What's fun? Spying on network activity is fun. If you have a HTTP service and you're debugging and totally at your wits' end, maybe it's time to look at what's REALLY EXACTLY being sent over the network...

these are your pals ♡

☆ ☆
execve ☆ ☆

On my first day of work, a Ruby script that ran some ssh commands wasn't working. Oh no!

But who wants to read code to find out why? ugh.

```
strace -f -e execve ./script.rb
```

told us what the problem ssh command was, and we fixed it!

a first cup of strace

You might think with all this talk of operating systems and system calls that using strace is hard.

Getting started is easy! If you have a linux machine I want you to try it RIGHT NOW.

Run: `strace ls`
Wizard time!

There's a LOT of output and it's pretty confusing at first. I've annotated some for you on the next page!!

try stracing more programs! Google the system calls! Don't worry if you don't understand everything! I sure don't!



my favorite
system calls

Have you ever not been sure what configuration files a program is using? THAT NEVER NEEDS TO HAPPEN TO YOU AGAIN!!!. Skip the docs and head straight for:

`strace -f -e open mplayer Rick-Astley.mp3`



open

write

Programs write logs.

If you're sure your program is writing Very Important Information but don't know what or where, `strace -e write` may be for you.

`read` is pretty great too.

annotated strace

When you run strace, you'll see thousands of lines of output like this:

```
$ strace ls /home/bork/blah
execve("/bin/ls", ["ls", "/home/bork/blah"], [/ 48 vars *]) = 0
brk(0) = 0x172c000
stat("/usr/local/lib", {st_mode=S_IFDIR|0755, st_size=4096, ...}) = 0
open("/etc/ld.so.cache", O_RDONLY|O_CLOEXEC) = 3
fstat(3, {st_mode=S_IFREG|0644, st_size=180820, ...}) = 0
mmap(NULL, 180820, PROT_READ, MAP_PRIVATE, 3, 0) = 0x7fe04e3f7000
close(3) = 0
open("/proc/filesystems", O_RDONLY) = 3 fstat(3, {st_mode=S_IFREG|0444, st_size
mmap(NULL, 4096, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) =
0x7fe04e423000
read(3, "nodev\tsysfs\nnodev\trootfs\nnodev\ttr"... , 1024) = 334
read(3, "", 1024) = 0
close(3) = 0
stat("/home/bork/blah", {st_mode=S_IFDIR|0775, st_size=4096, ...}) = 0
openat(AT_FDCWD, "/home/bork/blah", O_RDONLY|O_NONBLOCK|O_DIRECTORY|O_CLOEXEC) = 3
getdents(3, /* 3 entries */, 32768) = 80
getdents(3, /* 0 entries */, 32768) = 0
close(3) = 0
fstat(1, {st_mode=S_IFCHR|0620, st_rdev=makedev(136, 4), ...}) = 0
mmap(NULL, 4096, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) =
0x7fe04e423000
write(1, "awesome_file\n", 13) = 13
close(1) = 0
munmap(0x7fe04e423000, 4096) = 0
close(2) = 0
exit_group(0) = ?
```

Studies show this is not self-explanatory
(me asking my friends if it makes sense and NOPE NOPE)

★ let's learn how to interpret strace output ★

11999 execve("/usr/bin/ssh", ["ssh", "jvns.ca"]) = 0

① ② ③ ④

- ① The process ID (included when you run strace -f)
- ② The name of the system call (execve starts programs ☺)
- ③ The system call's arguments, in this case a program to start and the arguments to start it with
- ④ The return value.

Still the name of the syscall file to open open with read/write permissions

↓ ↓ ↓

open("awesome.txt", O_RDWR) = 3 ← file descriptor

The 3 here is a file descriptor number. Internally, Linux tracks open files with numbers! You can see all the file descriptors for process ID 42 and what they point to by doing

(ls -l /proc/42/fd) 'fd' is for file descriptor!

file descriptor what got read number of bytes read

↓ ↓ ↓

read(3, "wow! yay!") = 9

If you don't understand something in your strace output:

- it's normal! There are lots of syscalls.
- try reading the man page for the system call!

(man 2 open)

- remember that just understanding read + write + open + execve can take you a long way ♥